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(71) Applicant:
Bracco International B.V.
1077 ZX Amsterdam (NL)

(72) Inventors:
• Niedospial, John J. Jr.
Burlington, NJ 08016 (US)
• Gabbard, Mark E.
Delmar, DE 19940 (US)
• Gabbard, Timothy J.
Salisbury, MD 21804 (US)

(74) Representative:
Gervasi, Gemma, Dr.
NOTARBARTOLO & GERVASI Srl,
Corso di Porta Vittoria, 9
20122 Milano (IT)

(54) Universal stopper

(57) A universal closure assembly designed for use in various containers having a fluid port for access to the contents of a container (10). The universal closure assembly comprising an elastomeric membrane (60) capable of being ruptured by an access means such as a female luer connector (140) or a syringe having a sharp or blunt cannula or a sharp or blunt spike for fluid communication between the contents of the container (10) and the access means.

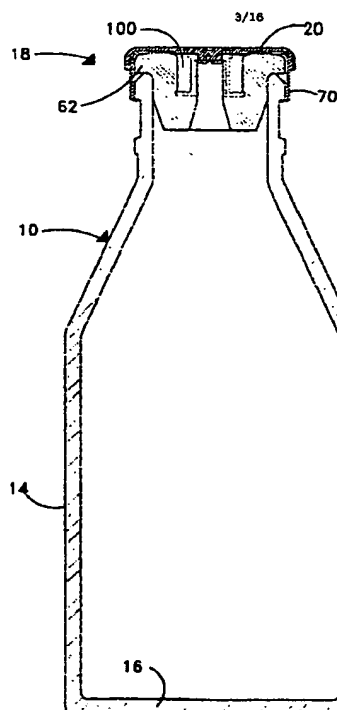


FIG. 4

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Description

1. Field of the Invention

- 5 [0001] This invention relates to a stopper having means to access pharmaceutical fluids contained in containers, such as bottles and vials for parenteral administration. More particularly, the invention relates to an elastomeric stopper for hermetically sealing a parenteral fluid container, such as a bottle or vial the content of which is accessed by the use of a luer connector or a syringe having a blunt or sharp needle cannula.

10 2. Background of the Invention

- [0002] The prior art has developed numerous devices to prevent accidental needle strike injuries to practitioners and patients. Such injuries are known to spread infectious diseases including hepatitis and AIDS. One of the main features of these devices is the lack of exposed sharp needles. The closures or stoppers have built in access means to the content of the containers, such as vials, cartridges and bottles. The closures or stoppers in these devices serve the dual function of hermetically sealing the container while allowing access to the content therethrough.

- [0003] Stopper systems for containers such as vials and bottles are made of materials that are resistant to chemicals and pharmaceuticals such as corrosive materials, reagents, parenteral solutions and solid formulations reconstitutable with a solvent prior to use. The most commonly used stopper/container system for such products has been glass or plastic bottles and vials equipped with stoppers made of elastomeric materials. The system provides for good hermetic seal, safe storage and easy access to the content through the elastomeric stopper via the use of an infusion spike or a syringe when withdrawal of the content is desired. The elastomeric stopper used generally comprises an elastomeric base, such as natural or synthetic rubber and an inert coating covering at least some portions of the stopper. The coating used includes chlorobutyl rubber, polymeric fluorocarbon resins such as polytetrafluoroethylene and various thermoplastic films. The coating is intended to insulate the elastomeric stopper base from the contents of the container in order to prevent contact and possible chemical reactions therebetween.

- [0004] Generally, the elastomeric stopper is of cylindrical shape and has a flange head portion overlying the open top end of the container. Integral with the head portion is a body portion which extends into the open end and seated in the neck portion of the container, the diameter of the body portion being somewhat larger than the inside diameter of the container so that a tight seal is created between the body portion and the wall of the container. The lower end of the body portion is beveled towards the central, longitudinal axis of the body portion to facilitate the insertion of the body portion into the container. The circular bottom surface that faces the contents of the container is substantially planar and is imperforate, having no recess therein. The head portion of the stopper is provided with a central recess extending downwardly from the top thereof a substantial distance into the body portion so that the central recess and the circular bottom surface define a diaphragm. The walls forming the recess are generally cylindrical but may be provided with one or more circular protuberances extending inwardly to terminate just short of the center line of the stopper. The circular protuberances serve to press against and hold the needle of a syringe when the needle is inserted through the recess to penetrate the diaphragm for removal of the contents of the container. The elastomeric stopper is held in position by a metal ring or cap usually constructed of aluminum. The metal ring or cap has a removable center opening for allowing insertion of the syringe needle into the container.

[0005] Another type of the prior art stoppers has the needle penetrable diaphragm on the top portion of the stopper.

[0006] Various stopper and access systems exist in the prior art to hold and remove the contents of containers which are illustrated hereunder.

- [0007] An example of a stopper according to the state of the art is reported in Figures 6 and 6A of the present application.

[0008] U.S. Patent No. 5,232,109 discloses an elastomeric stopper for a bottle, said stopper includes an annular protuberance which forms a second seal with the shaft of a spike inserted in the stopper to prevent leakage, blow-out and introduction of particulate matter into the fluid-containing bottle.

- [0009] U.S. Patent No. 5,429,256 pertains to a drug withdrawal system for a vial. The withdrawal system comprises: a vial containing a medicament therein and closed with a rubber gasket; and an apparatus which snap fits on top of the vial. The apparatus comprises: a chassis and a cap which is attached to the cap by a living hinge.

- [0010] The chassis is cylindrical and has vertical grooves on the external sides to facilitate handling. The top of the chassis has a central opening. The chassis includes a removable male luer lock adapter, having external threads thereon, including a ferrule structure the lower end of which has a hollow sharpened lance. The apparatus is used with a syringe having a female luer lock connector which snap fits with the removable male luer lock adapter including the ferrule.

[0011] In use, the cap cover is opened, and a syringe is screwed onto the outer end of the adapter. The syringe is then tightened on the adapter which moves the lance downward and the lance penetrates the gasket on the vial thereby

establishing flow communication with the content of the vial. The content of the vial is withdrawn by pulling back on the plunger of the syringe. The syringe is then removed with the content therein ready to receive a needle assembly for injecting the content into a patient.

5 [0012] The apparatus may be re-fitted with a new removable adapter 30 and a new ferrule 34 in the chassis 14. Thereafter the apparatus may be closed by cap 20.

[0013] U.S. Patent No. 5,433,330 relates to a needleless access stopper used on containers with a cannula having a blunt, stopper penetrating tip. The stopper is used in conjunction with a cannula having a blunt penetrating tip. The stopper includes a disc and a plug extending from the disc into the container. Also included is a diaphragm defined by a target region in the upper face. Also included is a centrally located piercing point positioned to pre-slit the diaphragm. This stopper is not suitable for syringe, cartridge or IV tubing having a female luer connector.

10 [0014] The present invention provides sealing and access means for containers, such as bottles or vials made of glass or plastic containing medical fluids, such as x-ray contrast media and parenteral liquids. The access means provides for hermetic sealing, safe handling, sterilization and storing. For convenience the invention will be described in combination with glass medicinal bottles. It is to be understood, however, that the invention includes sealing and access means for containers in general which comprise rigid or semi rigid access ports and are capable of receiving such sealing and access means.

SUMMARY OF THE INVENTION

20 [0015] The present invention provides a single use universal closure assembly allowing access to a medical fluid contained in a container with conventional access means available to healthcare professionals, such as cartridge or iv tubing equipped with a female luer connector or a syringe having sharp or blunt needle cannula or sharp and blunt spikes.

[0016] According to one aspect, the invention refers to a single use universal closure assembly allowing access to a medical fluid contained in the container with conventional access means comprising:

- 25
- (1) an elastomeric stopper for hermetically sealing a container at its open end; and
 - (2) a cylindrical housing or male element, open at both ends, which serves as a male connecting means.

[0017] The male connecting means preferably receives an external female access means, such as a female luer connector.

30 [0018] Preferably, the universal closure assembly according to the invention comprises:

- (1) an elastomeric stopper for hermetically sealing the container at its open end comprising:
- 35
- a head portion;
 - a skirt portion;
 - a cylindrical opening in the center of said head and skirt portions;
 - a hollow, vertically oriented thin elastomeric protuberance sealing the opening in the center portion of the elastomeric stopper designed to be ruptured by an external force;

- 40
- (2) a rigid, cylindrical housing having open ends enclosing said vertically oriented thin elastomeric protuberance to support said vertically oriented thin elastomeric protuberance and to serve as means for receiving and engaging a female luer connector whereby an external force moves the female luer connector which penetrates the thin elastomeric protuberance to establish fluid communication with the medical fluid contained in a container, said rigid cylindrical housing comprising: cylindrical walls having a top portion and a bottom portion, said top portion having locking ears designed to hold a female element of a luer connector, and said bottom portion sealed into the skirt portion of the elastomeric stopper.

The universal closure assembly according to the invention further comprises:

- 50
- (3) a cylindrical collar fastened over a portion of the elastomeric stopper and neck portion of a container to securely hold the elastomeric stopper in the open end of the container, said cylindrical collar having a central opening in its flat top portion to allow access to the elastomeric protuberance and the rigid cylindrical housing located in the center portion of said elastomeric stopper.

According to another aspect, the universal closure assembly according to the invention further comprises: (4) a removable cap.

55 [0019] According to a further aspect, the invention provides a universal closure assembly/container combination comprising:

- (a) a container;
- (b) a single closure assembly according to the invention.

[0020] According to another further aspect, the invention provides a method of assessing a medical fluid contained in a container equipped with the universal closure assembly of the present invention comprising the steps of:

- i) providing the universal closure assembly/container combination of the present invention;
- ii) removing the removable cap from the flat top and rim portions of the cylindrical collar thereby exposing the sealing membrane and the male element or connecting means in the cylindrical opening of the elastomeric stopper; and
- iii) accessing the medical fluid contained in the container by an access means.

[0021] According to a preferred aspect, the method comprises the following steps:

- i) providing a universal closure assembly/container combination comprising:

- (a) a container;
- (b) a closure assembly according to the invention,

wherein

said container (a), containing a medical fluid therein, having a neck portion terminating in an open end; said closure assembly (b), inserted into the open end of said container comprises:

- (1) an elastomeric stopper for hermetically sealing the container at its open end comprising:

- a head portion;
- a skirt portion;
- a cylindrical opening in the center of said head and skirt portions;
- a hollow, vertically oriented thin elastomeric protuberance sealing the opening in the center portion of the elastomeric stopper designed to be ruptured by an external force;

- (2) a rigid, cylindrical housing having open ends enclosing said vertically oriented thin protuberance to support said vertically oriented thin elastomeric protuberance and to serve as means for receiving and twistably engaging a female luer connector whereby an external force moves the female luer connector which penetrates the thin elastomeric protuberance to establish fluid communication with the medical fluid contained in said container, said rigid not-removable cylindrical housing comprising: cylindrical walls having a top portion and a bottom portion, said top portion having locking ears designed to hold a female element of a luer connector, and said bottom portion sealed into the skirt portion of the elastomeric stopper;
- (3) a cylindrical collar fastened over a portion of the elastomeric stopper and neck portion of the container to securely hold the elastomeric stopper in the open end of the container, said cylindrical collar having a central opening in its flat top portion to allow access to the elastomeric protuberance and the rigid cylindrical housing located in the center portion of said elastomeric stopper; and
- (4) a removable cap covering the flat top and rim portions of said cylindrical collar comprising retaining ears engaging said cylindrical collar to maintain said closure assembly in aseptic condition;

- (ii) removing said removable cap from said flat top and rim portions of said cylindrical collar; and
- (iii) accessing the medical fluid contained in said container by an access means.

[0022] The accessing means of step (iii) of the process is selected from various access means available to healthcare and emergency practitioners and sometimes to patients requiring self-injections, and providing for hermetic sealing, safe handling, sterilisation and storing. Preferably, the access means is a female luer connector or a syringe having a sharp or a blunt needle cannula or a sharp or blunt spike. However, it is preferred that the access means comprise no "sharps", such as in sharp needle cannulas, in order to prevent accidental injuries and transmittance of contagious diseases, such as AIDS

[0023] The female luer connector, preferably, comprises:

- (i) a cylindrical cap having thread means on the inside wall thereof;

(II) a tubing conduit having a fluid channel therein contained in said cylindrical cap and permanently attached to said cap by sealing means, wherein one end of the tubing conduit extends beyond the bottom rim portion of said cap and is designed to contact and rupture the vertically oriented thin elastomeric protuberance when said cylindrical cap is threaded onto said universal closure assembly to establish fluid communication with the content of the container.

5

[0024] The elastomeric stopper is made of an elastomeric base, such as a natural or synthetic rubber preferably having an inert, polymeric coating thereon covering at least the medical fluid contacting portions of the stopper. The coating may be of chlorobutyl rubber, polymeric fluorocarbon resins and thermoplastic films.

10 [0025] The elastomeric stopper is of cylindrical shape and has a flange head portion overlying the open top end of the container. Integral with the head portion is a skirt portion which extends into the open end and seated in the neck portion of the container, the diameter of the neck portion of the container being somewhat larger than the inside diameter of the skirt portion so that a tight seal is created between the skirt portion and the wall of the container.

[0026] In the center portion of the elastomeric stopper there is a cylindrical opening, extending through the head and the skirt portions of the stopper, and comprising a horizontally-oriented bottom portion which extends into the skirt and sealed thereto at the ring bottom portion of the elastomeric stopper. The cylindrical opening through the stopper body would expose the content of the container to the environment allowing contamination therefrom. In accordance with the present invention, the cylindrical opening accommodates a rupturable sealing membrane positioned in the opening. The sealing membrane is of cylindrical configuration having: a flat, horizontal base open in its center portion; cylindrical side walls extending from the flat, horizontal base to the head top surface of the stopper; and flat, horizontal top surface integral with the cylindrical side walls. The rupturable sealing membrane resembles an empty, up-side-down barrel which is open at its base. The rupturable sealing membrane is of thin, elastomeric material and is preferably integral with the elastomeric stopper.

25 [0027] The cylindrical opening also accommodates a rigid, cylindrical housing or male element, open at both ends, which serves as a male connecting means to receive an external female access means, such as a female luer connector. Such external access means are threaded into the male connecting means thereby rupturing the sealing membrane to establish fluid communication with the content of the container. The rigid cylindrical housing or male element also serves to support the thin, rupturable sealing membrane.

[0028] The cylindrical collar, preferably made of metal such as aluminum, is fastened over the elastomeric stopper and the neck portion of the container to securely hold the elastomeric stopper in the open end of the container. The cylindrical collar comprises a central opening in its flat top portion to allow access to the cylindrical opening in the stopper and to the sealing membrane and male element located in the cylindrical opening.

[0029] The removable cap covers the flat top and rim portions of the cylindrical collar and comprises retaining ears which engage the cylindrical collar to maintain the closure assembly in aseptic condition.

35 [0030] The container according to the combination and method of the invention is preferably made of glass, however, it can also be made of polymeric materials known in the art, containing medical fluids such as x-ray contrast media and parenteral liquids. The container has a neck portion terminating in an open end to receive the closure assembly which is inserted in the open end to seal the content therein and maintain it in sterile and aseptic condition. For convenience the invention will be described in combination with glass medicinal bottles. It is to be understood, however, that the invention includes sealing and access means for containers in general which comprise rigid or semi rigid access ports and are capable of receiving such sealing and access means

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BRIEF DESCRIPTION OF THE DRAWINGS

45 [0031] With reference to the annexed drawings, illustrating the invention:

- FIG. 1A is a perspective view of a container, a stopper with access means, and a cap covering the access means;
- FIG. 1B is a perspective view of the container and the stopper with access means shown in FIG. 1A without the cap;
- FIG. 2 is a top plan view of the container and the cap shown in FIG. 1A;
- 50 FIG. 3 is a top plan view of the container, the stopper with access means without the cap thereon shown in FIG. 1B;
- FIG. 4 is a cross-sectional view of the container, the stopper with access means and the cap covering the access means taken along the line 4-4 of FIG. 1A;
- FIG. 4A is a greatly enlarged cross-sectional view of the top of the container, the stopper with the access means and cap shown in FIG. 4;
- 55 FIG. 5A is a bottom plan view of the cap removed from the container shown in FIG. 1A;
- FIG. 5B is a sectional view of the cap removed from the container shown in FIG. 5A;
- FIG. 6 is a top plan view of a prior art stopper designed to be pierced by a spike;

- FIG. 6A is a cross-section of the prior art stopper of FIG. 6;
 FIG. 6B is a cross-section of the stopper of the present invention having a cylindrical protuberance in the center thereof which constitutes the seal or diaphragm in the stopper penetrable by various access means;
 FIG. 7 is a top plan view of the access means housing;
 5 FIG. 7A is a cross-section of the access means housing;
 FIG. 8 is a cross-section of the stopper, the access means housing in the stopper and elastomeric seal or diaphragm supported by the housing;
 FIG. 9 is the elastomeric seal removed from the stopper shown in cross-section in FIG. 8;
 FIG. 9A is a top plan view of the elastomeric seal shown in cross-section in FIG. 9;
 10 FIG. 10 is a cross-sectional view of the elastomeric seal having a generally dome-shaped configuration in the center thereof;
 FIG. 10A is the top plan view of the elastomeric seal shown in cross-sectional view in Fig. 10;
 FIG. 11 shows a cross-section of a female luer connector with screw threads;
 FIG. 12 is a cross-section of a female luer connector which is to engage access means housing shown in FIGS.
 15 7, 7A and 8, wherein the female luer connector and access means housing are shown prior to their engagement;
 Fig. 12 A is a cross-section of the female luer connector partially engaging access means housing and rupturing the elastomeric seal shown in Fig. 12;
 FIG. 12B is a cross-sectional view of the female luer connector completely engaging access means housing; and
 20 FIG. 13 is a cross-sectional view of the female luer connector disengaging access means housing.

DETAILED DESCRIPTION OF THE INVENTION

25 [0032] Referring to FIGS. 1A, 1B, 2, 3, 4, and 4A, the container 10 having an open end in which the universal stopper is used comprises a neck portion 12, a side portion 14, and a bottom portion 16. In the open end of neck portion 12 is located the universal stopper held securely in place by cylindrical collar 70 having an open area 71 in its top center portion said open area being defined by the circular rim denoted by the numeral 74. Cylindrical collar further comprises a flat top surface 75 defined by circular rims 74 and 76 and top rim portion 73. Cylindrical collar 70 is crimped at its bottom rim 72 to neck portion 12 of the container. Flat top surface 75 is covered by a cylindrical, removable cap 18 which comprises a flat top portion 20, and a side rim portion 22 which overlaps top rim portion 73 of cylindrical collar 70. FIG. 1B shows locking ears 50 constituting a part of the universal stopper which is described later in reference to other Figures as the description of the invention proceeds.

35 [0033] Referring to FIGS. 1B, 5A and 5B, removable cap 18 covers flat top surface 75 and top rim portion 73 of cylindrical collar to maintain open area in top center portion 71 of cylindrical collar and locking ears 50 in aseptic condition during storage. Removable cap 18 comprises: side rim portion 22, flexible retaining ears 24, and retainer button 26. When in place, retaining ears 24 are slid under circular rim 74 in cylindrical collar 70 providing a tight seal between removable cap 18 and flat top surface 75 of cylindrical collar. Retainer button 26 together with retaining ears 24 also serve to limit expansion of the thin elastomeric membrane or seal during sterilization.

40 [0034] Referring to FIGS. 1A, 1B, 4, 4A, 6, 6A and 8, the open end of the container 10 is to receive an elastomeric stopper 60 having a top surface 63 and a bottom surface 65 and comprises: a head 62 and a skirt 64 integral therewith. The head comprises a flange 66, extending laterally outwardly from skirt 64 and is designed to cover the transverse end surface of the container. The elastomeric stopper shown in FIGS. 6 and 6A is conventionally used by the prior art. In the present invention, as best seen in FIGS. 4A and 8, the elastomeric stopper further comprises: a cylindrical opening 68 in its center portion defined by cylindrical walls denoted by the numerals 80 and 80'; bottom ring portion denoted by the numerals 82 and 82'; and funnel shaped opening 83 extending downward from the bottom ring portion into the container defined by walls 84 and 84'. Projecting upward towards the top surface 63 of elastomeric stopper 60 is a hollow, vertically-oriented, cylindrical protuberance 85 defined by cylindrical walls 86 and 86' and top surface 120. Top surface 120, along with cylindrical walls 86 and 86', are designed to serve as the elastomeric seal in the elastomeric stopper. The cylindrical protuberance is preferably integral with the stopper body such as produced by blow molding technique or it may be produced separately and sealed into the central opening defined by walls 80 and 80' in the elastomeric stopper 60.
 50

[0035] The vertically-oriented cylindrical protuberance is of thin, membrane-like material designed to be ruptured by an external force exerted on the protuberance by an access means, such as a luer connector.

55 [0036] In reference to FIGS. 7, 7A and 8, in order to support vertically-oriented cylindrical protuberance 85 and to provide a means for receiving a male luer connector, a housing or male element generally designated as 100, is provided, located in the upper center portion 68 of elastomeric stopper 60. Housing 100 comprises: cylindrical wall 102 having a top surface 104 and bottom surface 106. Cylindrical wall 102 comprises an inside wall 108, an outside wall 110, locking ears 50, and horizontally-oriented bottom portion 112. Locking ears 50 is designed to securely hold a

female element of a luer connector. Horizontally-oriented bottom portion 112 extends into the skirt 64 and sealed thereto at the bottom ring portion 82 and 82' of elastomeric stopper 60.

[0037] The cylindrical protuberance serving as a sealing membrane is of inert gas-impermeable polymeric material capable of flexing under internal or external pressures such as exerted during steam sterilization. Preferably the membrane has a thickness of from about 0.001 mm to about 1.00 mm and a durometer of from about 25 to about 80 Shore A. Suitable elastomeric materials for constructing the membrane include:

- natural rubber;
- acrylate-butadiene rubber;
- 10 cis-polybutadiene;
- chlorobutyl rubber;
- chlorinated polyethylene elastomers;
- polyalkylene oxide polymers;
- ethylene vinyl acetate;
- 15 fluorosilicone rubbers;
- hexafluoropropylene-vinylidene fluoride-tetrafluoroethylene terpolymers, such as sold under the tradenames of Fluorel and Viton;
- butyl rubbers;
- polyisobutene, such as sold under the tradename Vistanex;
- 20 synthetic polyisoprene rubber;
- silicone rubbers;
- styrene-butadiene rubbers;
- tetrafluoroethylene propylene copolymers;
- thermoplastic-copolyesters; and
- 25 and any new elastomeric materials.

[0038] The cylindrical protuberance serving as sealing means has a horizontal top surface or membrane 120 as shown in FIG. 9 in a cross-sectional view and top plan view in FIG. 9A. The cylindrical protuberance positioned in elastomeric stopper 60 so that its top surface 120 is spaced about 2 to 3 mm from retainer button 26 of removable cap 18 when the cap is placed on container 10. The spacing allows the membrane to flex outwardly under pressure, such as created under heat sterilization. However, spacing should not be more than about 2 to 3 mm so that under accidentally high pressures, bursting of the membrane is prevented by the retaining button 26 of removable cap 18.

[0039] FIGS. 10 and 10A show an elastomeric membrane having a generally dome-shaped configuration in the center thereof. The dome-shaped configuration 124 rises over the horizontal portion 126 towards the top surface of the elastomeric stopper. The configuration allows easy rupture of the membrane when a female luer connector is threaded into universal stopper in order to establish fluid communication between the content of the container and the female luer connector. Preferably, the membrane has a thickness of from about 0.001 mm to about 1.00 mm and a durometer of from about 25 to about 80 Shore A.

[0040] The universal stopper of the present invention is preferably used with a female luer connector when fluid communication is desired with the content of the container stoppered by the universal stopper. A typical female luer connector 140 is shown in FIG. 11 and comprises: cylindrical outside wall 142 and cylindrical inside wall 143 having an opening in their center portion for accommodating a tubing within the inside wall. Cylindrical ring 144 located in the top center portion of cylindrical inside wall 143 tightly holds tubing 160 which has a fluid communicating channel 162. Cylindrical inside wall 143 further comprises integral screw threads 146, 148, 150 and 152 which, upon connecting the female luer connector to the male luer connector, engages locking ears 50 on the housing or male element 100, as shown in FIGS. 7 and 7A. Other type of female luer connectors, such as snap-on connectors may also be used.

[0041] FIG. 12 shows, in cross-sectional view, a syringe having a female luer connector, which is to engage universal stopper shown in Fig. 8, wherein the syringe and universal stopper are shown prior to their engagement. When it is desired to deliver medical fluid from container 10 to a patient, removable cap 18 is removed by an upward manual pressure exerted on its rim portion 22 thereby exposing locking ears 50 of the access means housing.

[0042] If the female luer connector of FIG. 11 is used it is attached to universal stopper by twisting motion wherein threads 146, 148, 150 and 152 engage locking ears 50 of access means housing 100. Upon turning the female luer connector 140, end portion of tubing 160 ruptures membrane of the universal stopper to establish fluid communication with the content of the container.

55 [0043] FIG. 12A shows, in cross-sectional view, the syringe having the female luer connector partially engaging the universal stopper.

[0044] FIG. 12B shows, in cross-sectional view, the syringe having the female luer connector completely engaging the universal stopper.

[0045] FIG. 13 shows, in cross-sectional view, the syringe having the female luer connector removed from the universal stopper after their engagement.

[0046] The universal stopper can be engaged by a female luer connector having a blunt end which engages and ruptures the cylindrical seal in the center of the universal stopper. However, the universal stopper also allows access to the content of the container by a sharp or blunt needle cannula or a spike.

Materials of Construction and Use

[0047] The elastomeric stopper used in conjunction with the universal stopper of the present invention is fluid impervious, resilient, and inert with low leachable additives therein in order to prevent any alteration of the product contained in the container. It may be of a single component or a blend of components. Examples of materials include synthetic and natural rubbers, such as butyl rubber, isoprene rubber, silicone rubber, halogenated rubber, ethylene propylene terpolymer and the like. Specific examples of a synthetic elastomeric rubber include the $\text{CH}_2\text{CF}_2\text{-C}_3\text{F}_6(\text{C}_3\text{F}_5\text{H})$ and the $\text{C}_2\text{F}_4\text{-C}_2\text{F}_3\text{OCF}_3$ series of elastomers made by DuPont under the trade names of VITON[®] and CARLEZ[®]; the fluoro-silicone rubbers, such as those made by Dow Corning under the trade name of SILASTIC[®]; and polyisobutylenes, such as VISTANEX MML-100 and MML-140; and halogenated butyl rubber, such as CHLOROBUTYL 1066, made by Exxon Chemical Company.

[0048] These or other suitable elastomers may be made into the desired stopper configuration by known methods. Such methods conventionally include the use of a curing agent, a stabilizer and a filler and comprise a primary and a secondary curing step at elevated temperatures.

[0049] The container used in conjunction with the present invention may be of glass or a polymeric material, i.e., plastic, which are well known in the pharmaceutical industry. When the container is made of glass, it is in the shape of a vial or bottle. The vial or bottle is of rigid or semi-flexible polymeric material. In all shapes the container is provided with a neck portion which is rigid and retains its configuration so that it is capable of being hermetically sealed by the elastomeric universal stopper of the present invention. The container may have a volume capacity of from 5 ml to 1000 ml or more, preferably about 10 ml to 500 ml.

[0050] The mouth of the container is to receive the universal stopper. The external diameter of the stopper is slightly larger than the internal diameter of the neck of the container so that on insertion of the universal stopper into the mouth of the container, a tight, hermetic seal is achieved.

[0051] The cylindrical collar is preferably made of metal, such as aluminum, while the housing is made of hard plastic known by the prior art and used in conjunction with pharmaceutical fluids.

[0052] Prior to use, the container and component parts of the closure are sterilized and the container is filled with a pharmaceutical fluid, such as a parenteral solution. The universal stopper is inserted, hermetically sealing the content of the container. Cylindrical collar is then crimped onto the container to securely hold the universal stopper in the container. Lastly, the removable cap is snapped onto the cylindrical collar to complete the closing of the container.

PARTS LIST

5	Container	10
	Neck portion of container	12
	Side portion of container	14
10	Bottom portion of container	16
	Cylindrical collar on container	70
	Open area in top center portion of cylindrical collar	71
15	Top rim portion of cylindrical collar	73
	Open area in top center portion of cylindrical rim	74
	Flat top surface of cylindrical collar	75
20	Circular rims defining flat top surface of cylindrical collar	74, 76
	Removable cap	18
	Flat top portion of removable cap	20
25	Side rim portion of removable cap	22
	Flexible retaining ears	24
	Retainer button	26
30	Locking ears	50
	Elastomeric stopper	60
	Head of elastomeric stopper	62
35	Top surface of elastomeric stopper	63
	Skirt of elastomeric stopper	64
	Bottom surface of elastomeric stopper	65
40	Flange of elastomeric stopper	66
	Elastomeric seal in prior art stopper	67
	Cylindrical opening in elastomeric stopper	68
45	Cylindrical walls defining the cylindrical opening in elastomeric stopper	80, 80'
	Bottom ring portion in the opening of elastomeric stopper defined by	82, 82'
50	Funnel-shaped opening in skirt of elastomeric stopper	83
55		

PARTS LIST (contd.)

5	Walls of funnel-shaped opening	84, 84'
	Cylindrical protuberance constituting the seal in elastomeric stopper	85
	Walls of cylindrical protuberance	86, 86'
10	Top surface membrane of cylindrical protuberance	120
	Housing of male element	100
15	Cylindrical wall of housing	102
	Top surface of housing	104
	Bottom surface of housing	106
20	Inside wall of housing	108
	Outside wall of housing	110
	Horizontally oriented bottom portion of housing	112
25	Dome shape portion in top surface of cylindrical protuberance	124
	Horizontal surface of cone-shaped configuration	126
	Female luer connector	140
30	Cylindrical outside wall of female luer connector	142
	Cylindrical inside wall of female luer connector	143
	Cylindrical ring of female luer connector	144
35	Tubing in female luer connector	160
	Fluid communicating channel in tubing	162
40	Integral screw threads in inside wall of female luer connector	146, 148, 150, 152

45 **[0053]** The present invention has been described in connection with the preferred embodiment shown in the drawings, however, various changes and modifications will be apparent to those skilled in the art.

Claims

- 50 1. A universal closure assembly allowing access to a medical fluid contained in a container (10) with conventional access means comprising:
- (1) an elastomeric stopper (60) for hermetically sealing a container (10) at its open end; and
- (2) a cylindrical housing (100), open at both ends, which serves as a male connecting means.
- 55 2. The universal closure assembly according to claim 1, wherein said male connecting means receives an external female access means.

3. The universal closure assembly according to claim 2, wherein said external female access means is a female luer connector (140).
- 5 4. The universal closure assembly according to claim 1, wherein said elastomeric stopper (60) comprises a hollow, vertically oriented thin elastomeric protuberance (85) sealing the opening in the center portion of the elastomeric stopper designed to be ruptured by an external force.
5. The universal closure assembly according to claim 1, wherein said elastomeric stopper (60) for hermetically sealing the container at its open end comprises:
10 a head portion (62);
 a skirt portion (64);
 a cylindrical opening (68) in the center of said head (62) and skirt (64) portions;
 a hollow, vertically oriented thin elastomeric protuberance (85) sealing the opening in the center portion (120)
15 of the elastomeric stopper designed to be ruptured by an external force.
6. The universal closure assembly according to claims 4-5, wherein said vertically oriented cylindrical protuberance (85) is of inert, gas-impermeable polymeric material selected from the group consisting of:
20 natural rubber;
 acrylate-butadiene rubber;
 cis-polybutadiene;
 chlorobutyl rubber;
 chlorinated polyethylene elastomers;
25 polyalkylene oxide polymers;
 ethylene vinyl acetate;
 fluorosilicone rubbers;
 hexafluoropropylene-vinylidene fluoride-tetrafluoroethylene terpolymers;
 butyl rubbers;
30 polyisobutene;
 synthetic polyisoprene rubber;
 silicone rubbers;
 styrene-butadiene rubbers;
 tetrafluoroethylene propylene copolymers; and
35 thermoplastic-copolyesters.
7. The universal closure assembly according to claims 4-6, wherein said vertically oriented cylindrical protuberance (85) has a thickness of from about 0.001 mm to about 1.00 mm and a durometer of from about 25 to about 80 Shore A.
- 40 8. The universal closure assembly according to claims 4-7, wherein said vertically oriented cylindrical protuberance (85) is of dome-shape, cone-shape or conic-section configuration.
9. The universal closure assembly according to claims 4-8, wherein said vertically oriented cylindrical protuberance (85) reseals itself after puncture by a fluid access means.
- 45 10. The universal closure assembly according to claim 1, wherein said rigid, cylindrical housing (100) has open ends enclosing a vertically oriented thin elastomeric protuberance (85) to support said vertically oriented thin elastomeric protuberance (85) and to serve as means for receiving and engaging a female luer connector (140) whereby
50 an external force moves the female luer connector (140) which penetrates the thin elastomeric protuberance (85) to establish fluid communication with the medical fluid contained in the container (10), said rigid not removable cylindrical housing (100) comprising: cylindrical walls (102) having a top portion (104) and a bottom portion (106), said top portion (104) having locking ears (50) designed to hold a female element of a luer connector, and said bottom portion (106) sealed into the skirt portion (64) of the elastomeric stopper.
55
11. The universal closure assembly according to claim 1, wherein said access means comprises a luer connector or a syringe having a sharp or blunt needle cannula or a sharp or blunt spike.

12. The universal closure assembly according to claims 1-11, further comprising: a cylindrical collar (70) fastened over a portion of the elastomeric stopper (60) and neck portion (12) of a container (10) to securely hold the elastomeric stopper (60) in the open end of the container, said cylindrical collar (70) having a central opening in its flat top portion (75) to allow access to the elastomeric protuberance (85) and the rigid cylindrical housing (100) located in the center portion of said elastomeric stopper (60).

13. The universal closure assembly according to claims 1-12, further comprising a removable cap (18) covering the flat top (75) and rim (74, 76) portions of said cylindrical collar (70).

14. A universal closure assembly/container combination comprising:

- (a) a container (10);
- (b) a single use closure assembly according to claims 1-13.

15. A universal closure assembly/container combination to claim 14, wherein

said container (10), containing a medical fluid therein, having a neck portion (12) terminating in an open end; said closure assembly, having an access means allowing withdrawal of said medical fluid from the container (10) by the use of a luer connector having an intravenous tubing, a sharp or blunt needle cannula or a spike, is inserted into the open end of said container (10) and comprises:

(1) an elastomeric stopper (60) for hermetically sealing the container (10) at its open end comprising:

- a head portion (62);
- a skirt portion (64);
- a cylindrical opening (68) in the center of said head (62) and skirt (64) portions;
- a hollow, vertically oriented thin elastomeric protuberance (85) sealing the opening in the center portion of the elastomeric stopper (60) designed to be ruptured by an external force;

(2) a rigid, cylindrical housing (100) having open ends enclosing said vertically oriented thin elastomeric protuberance (85) to support said vertically oriented thin elastomeric protuberance (85) and to serve as means for receiving and engaging a female luer connector (140) whereby an external force moves the female luer connector (140) which penetrates the thin elastomeric protuberance (85) to establish fluid communication with the medical fluid contained in said container (10), said rigid cylindrical housing (100) comprising: cylindrical walls (102) having a top portion (104) and a bottom portion (106), said top portion (104) having locking ears (50) designed to hold a female element (140) of a luer connector, and said bottom portion (104) sealed into the skirt portion (64) of the elastomeric stopper (60);

(3) a cylindrical collar (70) fastened over a portion of the elastomeric stopper (60) and neck portion (12) of the container (10) to securely hold the elastomeric stopper (60) in the open end of the container (10), said cylindrical collar (70) having a central opening in its flat top portion (75) to allow access to the elastomeric protuberance (85) and the rigid cylindrical housing (100) located in the center portion of said elastomeric stopper (60); and

(4) a removable cap (18) covering the flat top (75) and rim (74,76) portions of said cylindrical collar (70) comprising retaining ears engaging said cylindrical collar to maintain said closure assembly in aseptic condition.

16. The universal closure assembly/container combination of claim 14 wherein said container (10) is made of glass.

17. The universal closure assembly/container combination of claim 14 wherein said container (10) is a vial.

18. The universal closure assembly/container combination of claim 14 wherein said container (10) is a bottle.

19. The universal closure assembly/container combination of claim 14 wherein said container (10) is made of a polymeric material.

20. The universal closure assembly/container combination of claim 14 wherein the medical fluid, contained into said container (10), is a parenteral liquid.

21. The universal closure assembly/container combination of claim 20 wherein said parenteral liquid is an x-ray contrast medium.
22. The universal closure assembly/container combination of claim 20 wherein said parenteral liquid is a therapeutic liquid.
23. The universal closure assembly/container combination of claim 14 wherein the volume capacity of said container is of from about 5 ml to about 1000 ml.
24. A method of assessing a medical fluid contained in a container (10) equipped with a universal closure assembly, allowing access to a medical fluid contained in said container (10) with conventional access means, comprising the steps of:
 - i) providing a universal closure assembly/container combination comprising a container (10) and a universal assembly, said closure assembly, being inserted into the open end of said container (10), comprising:
 - (1) an elastomeric stopper (60) for hermetically sealing a container (10) at its open end;
 - (2) a cylindrical housing (100), open at both ends, which serves as a male connecting means;
 - (3) a cylindrical collar (70); and
 - (4) a removable cap (18);
 - ii) removing the removable cap (18) from the flat top (75) and rim (74,76) portions of the cylindrical collar (70) thereby exposing the sealing membrane and the male element or connecting means in the cylindrical opening of the elastomeric stopper (60); and
 - iii) accessing the medical fluid contained in the container (10) by an access means.
25. The method according to claim 24, wherein said elastomeric stopper (60) for hermetically sealing the container at its open end comprising:
 - a head portion (62);
 - a skirt portion (64);
 - a cylindrical opening (68) in the center of said head (62) and skirt (64) portions;
 - a hollow, vertically oriented thin elastomeric protuberance (85) sealing the opening in the center portion of the elastomeric stopper (60) designed to be ruptured by an external force.
26. The method of claim 24, wherein said cylindrical housing (100) has open ends enclosing said vertically oriented thin protuberance (85) to support said vertically oriented thin elastomeric protuberance (85) and to serve as means for receiving and twistably engaging a female luer connector (140) whereby an external force moves the female luer connector (140) which penetrates the thin elastomeric protuberance (85) to establish fluid communication with the medical fluid contained in said container (10), said rigid not removable cylindrical housing (100) comprising: cylindrical walls (102) having a top portion (104) and a bottom portion (106), said top portion (104) having locking ears (50) designed to hold a female element of a luer connector, and said bottom portion (106) sealed into the skin portion (64) of the elastomeric stopper (60).
27. The method of claim 24, wherein said cylindrical collar (70) is fastened over a portion of the elastomeric stopper (60) and neck portion (12) of the container (10) to securely hold the elastomeric stopper (60) in the open end of the container (10), said cylindrical collar (70) having a central opening in its flat top portion (75) to allow access to the elastomeric protuberance (85) and the rigid cylindrical housing (100) located in the center portion of said elastomeric stopper (60).
28. The method of claim 24, wherein said removable cap (18) covering the flat top (75) and rim (74,76) portions of said cylindrical collar (70) comprising retaining ears engaging said cylindrical collar (70) to maintain said closure assembly in aseptic condition.
29. The method of claim 24 or 26, wherein said access means is a female luer connector (140) comprising:
 - (a) a cylindrical cap having thread means on the inside wall thereof;
 - (b) a tubing conduit (160) having a fluid channel (162) therein contained in said cylindrical cap and perma-

nently attached to said cap by sealing means, wherein one end of the tubing conduit (160) extends beyond the bottom rim portion of said cap and is designed to contact and rupture the vertically oriented thin elastomeric protuberance (85) when said cylindrical cap is threaded onto said universal closure assembly to establish fluid communication with the content of the container (10).

30. The method of claim 24, wherein said access means is a syringe having a sharp or blunt needle cannula or a sharp or blunt spike.

31. The method of claim 25, wherein said vertically oriented thin elastomeric protuberance (85) has a thickness of from about 0.001 mm to about 1.00 mm and a durometer of from about 25 to about 80 Shore A.

32. The method of claim 25, wherein said vertically oriented thin elastomeric protuberance (85) is of an elastomeric material selected from the group consisting of:

natural rubber;
acrylate-butadiene rubber;
cis-polybutadiene;
chlorobutyl rubber;
chlorinated polyethylene elastomers;
polyalkylene oxide polymers;
ethylene vinyl acetate;
fluorosilicone rubbers;
hexafluoropropylene-vinylidene fluoride-tetrafluoroethylene terpolymers;
butyl rubbers;
polyisobutene;
synthetic polyisoprene rubber;
silicone rubbers;
styrene-butadiene rubbers;
tetrafluoroethylene propylene copolymers; and
thermoplastic-copolyesters.

33. The method of claim 24, wherein said medical fluid is a therapeutic liquid.

34. The method of claim 24, wherein said medical fluid is a diagnostic liquid.

35. The method of claim 24, wherein said medical fluid is a nutritional liquid.

FIG. 1B

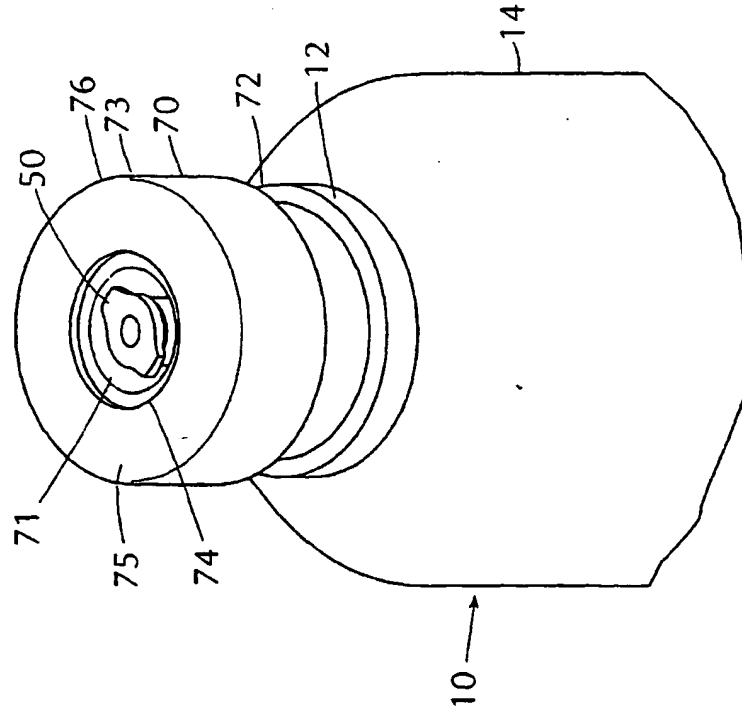


FIG. 1A

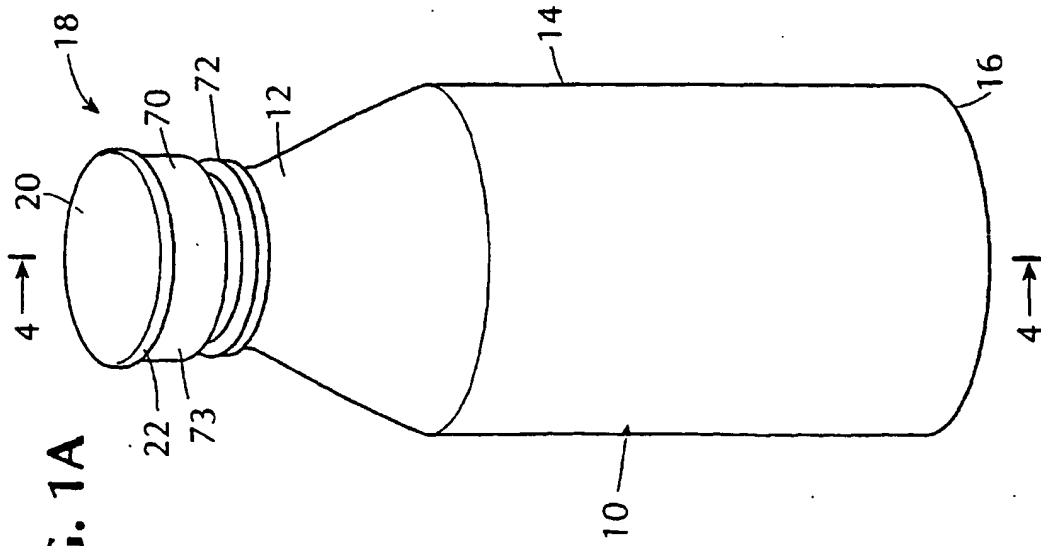


FIG. 2

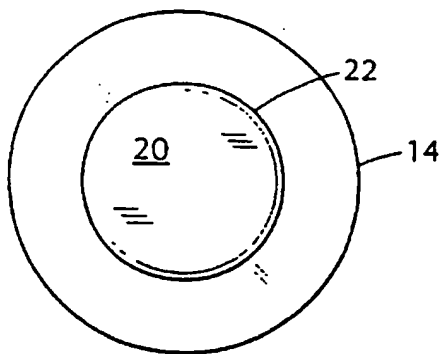
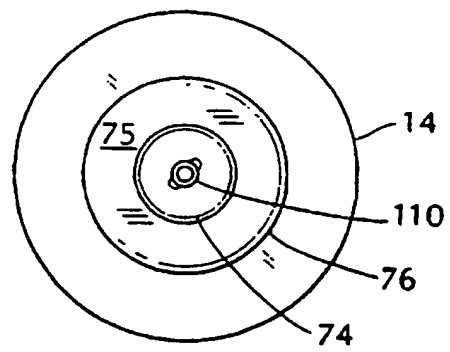


FIG. 3



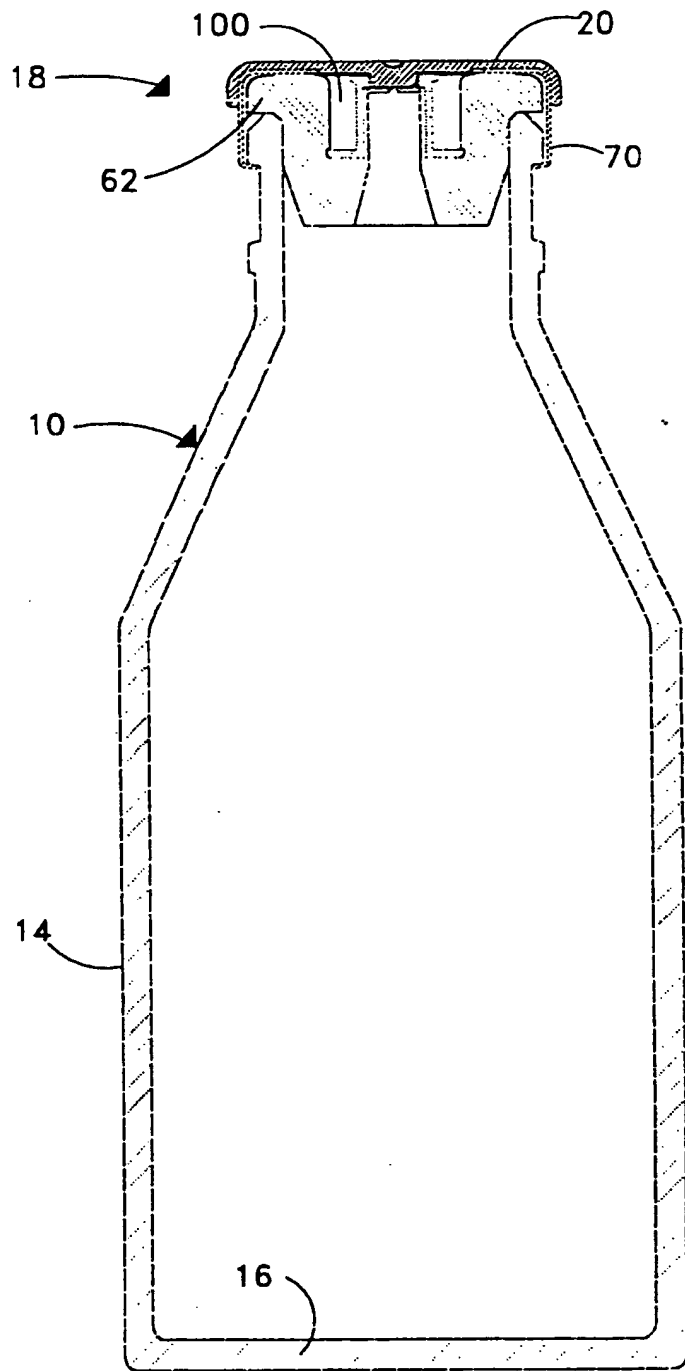


FIG. 4

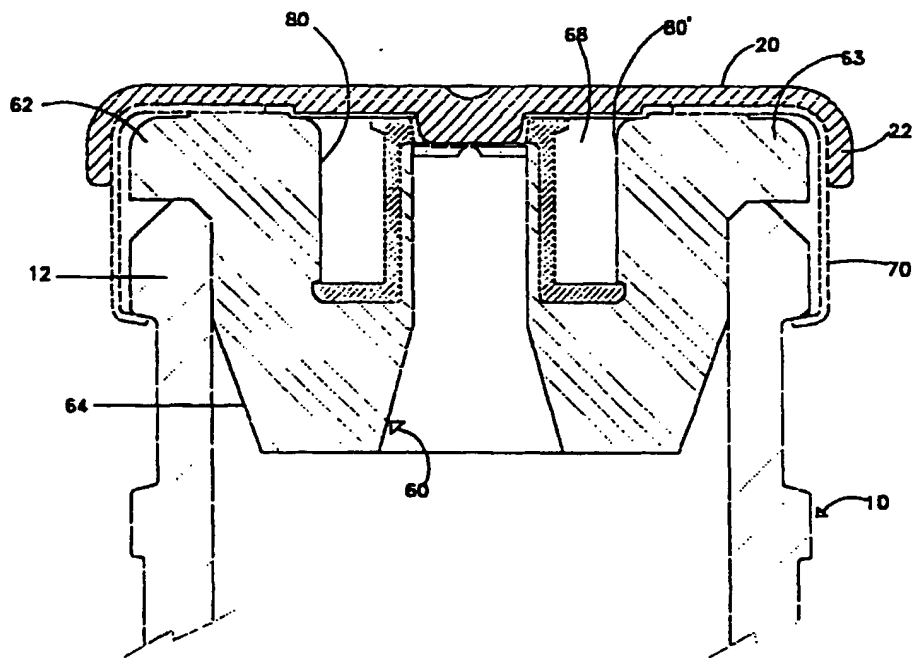


FIG. 4A

FIG. 5A

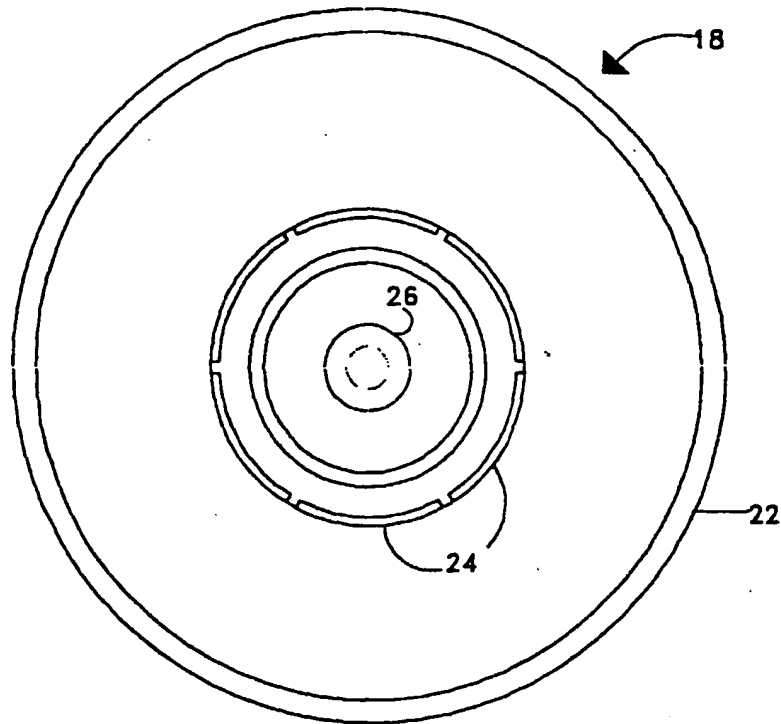


FIG. 5B

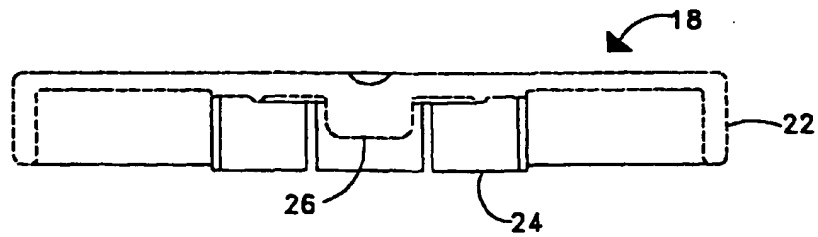


FIG. 6

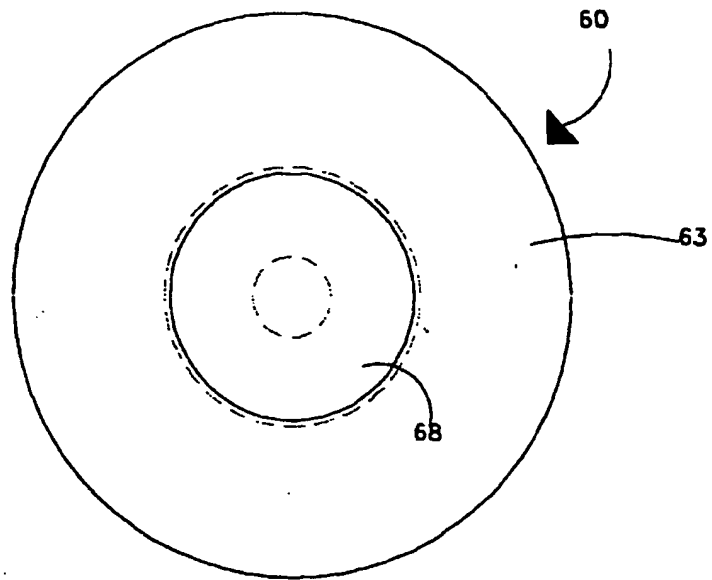
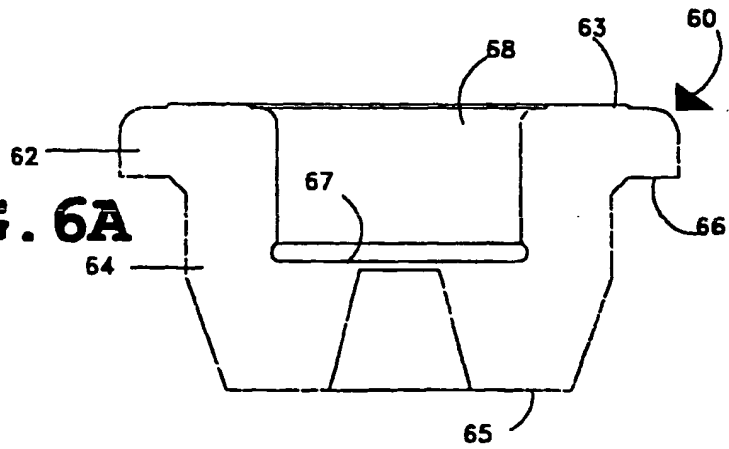


FIG. 6A



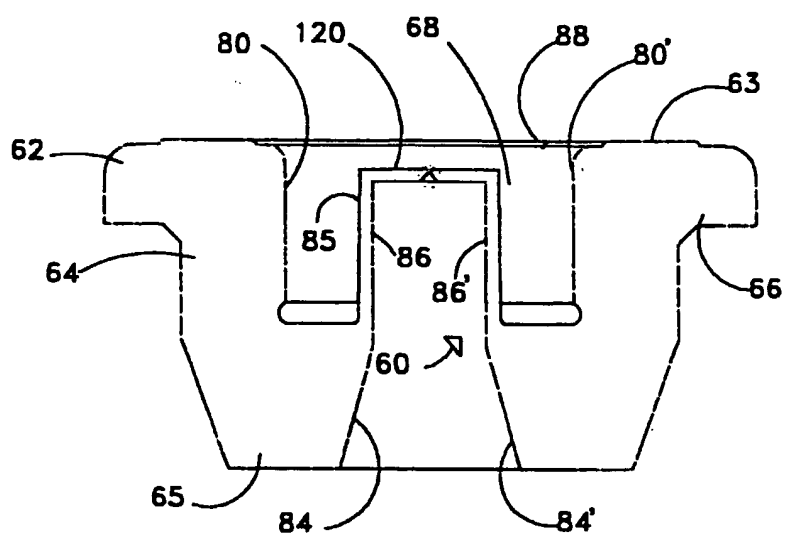


FIG. 6B

FIG. 7A

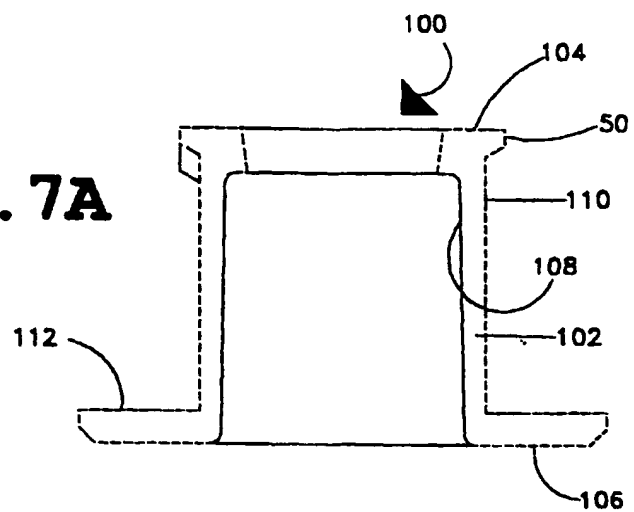
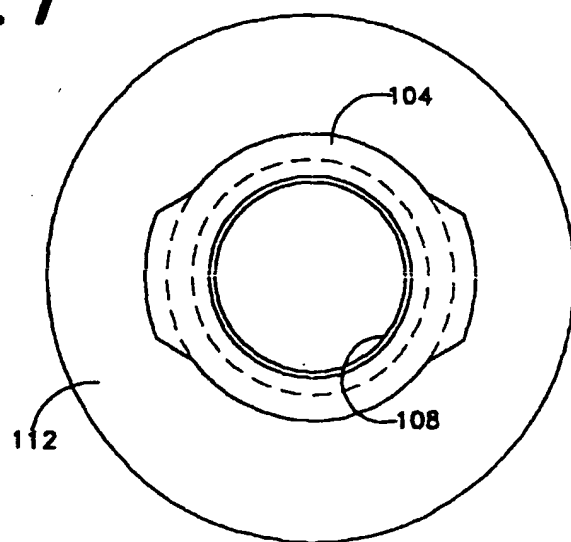


FIG. 7



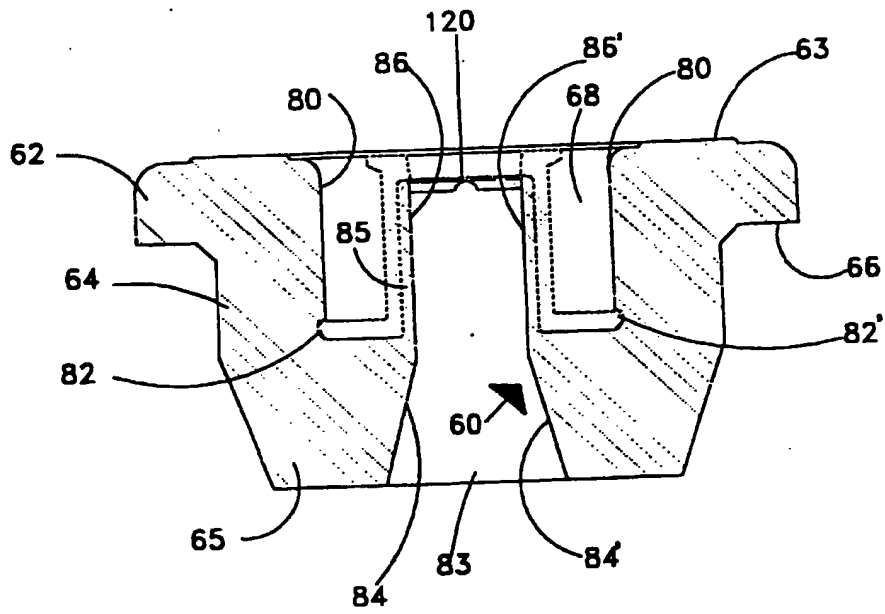


FIG. 8

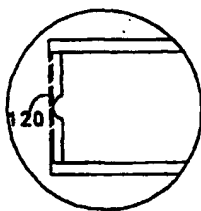
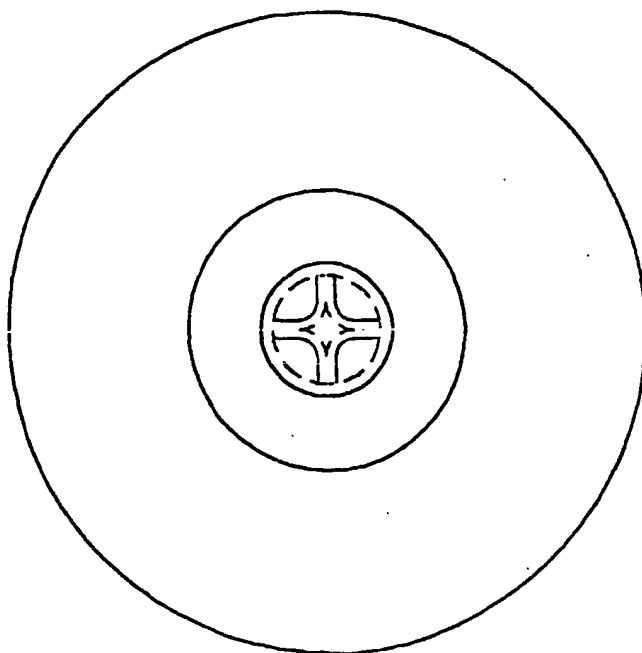


FIG. 9

FIG. 9A



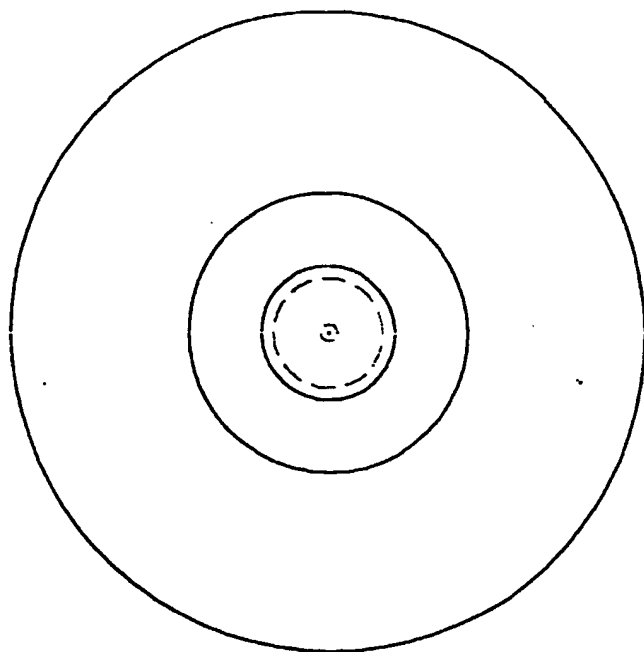


FIG. 10A

FIG. 10

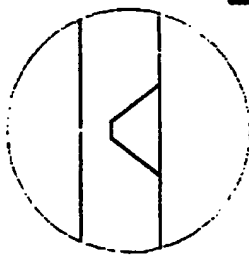
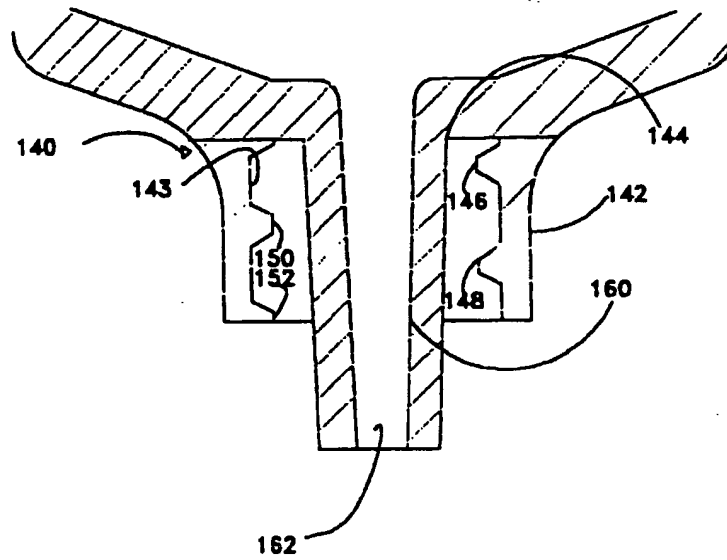


FIG. 11



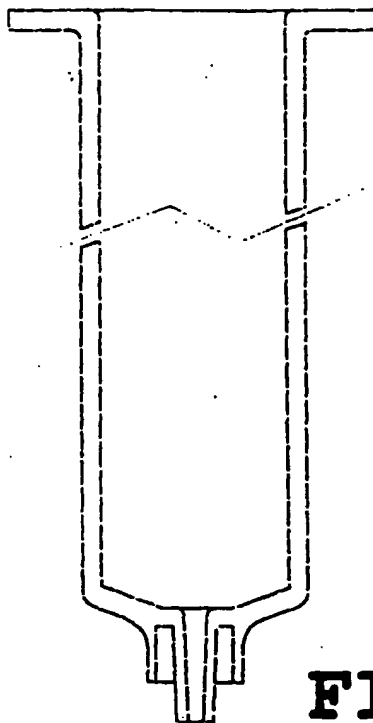
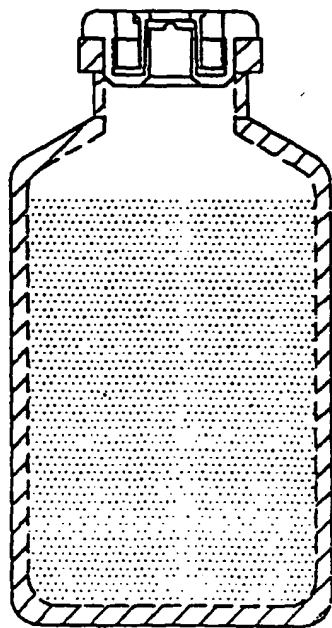


FIG. 12



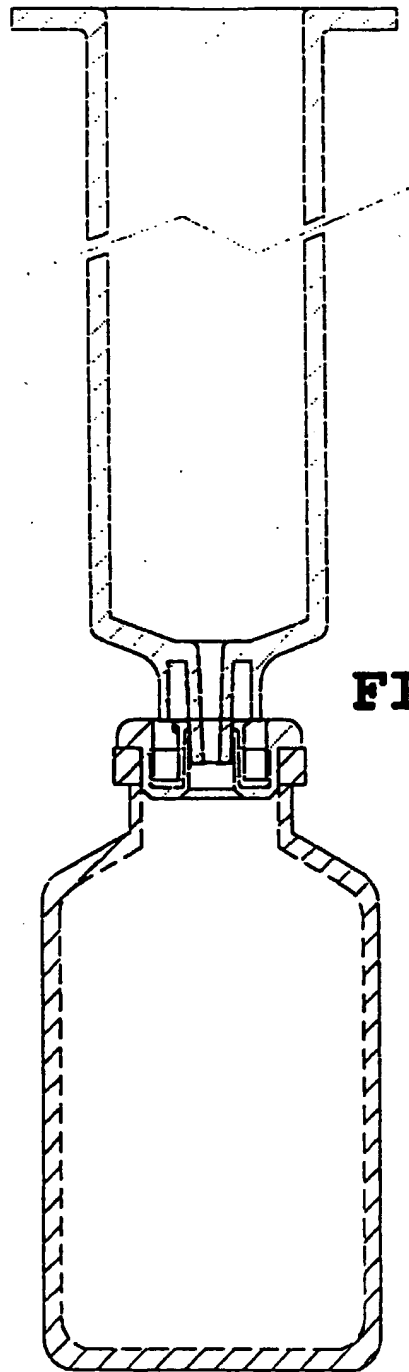


FIG. 12A

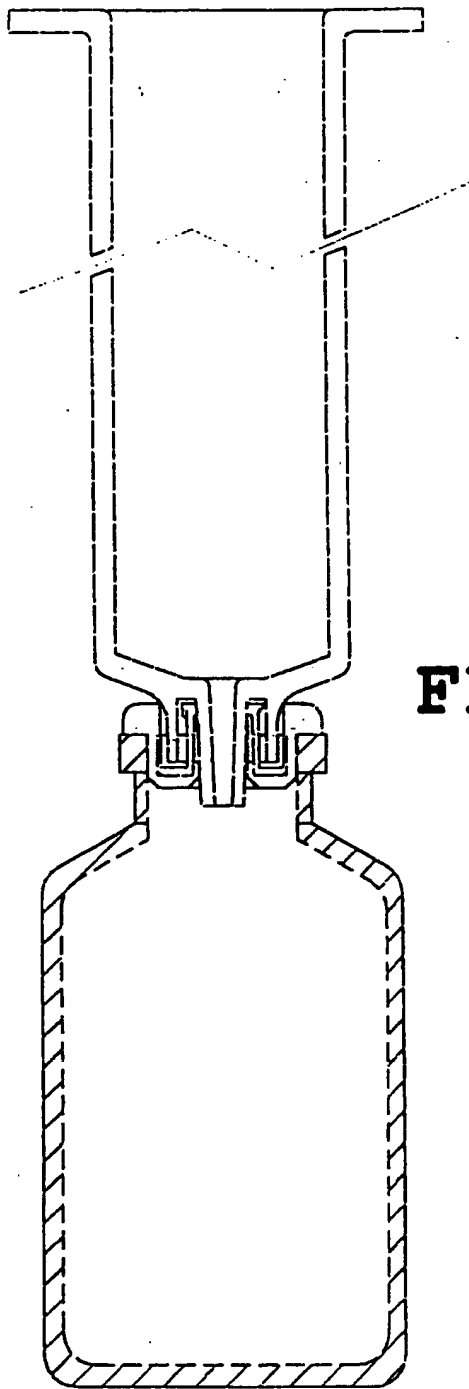


FIG. 12B

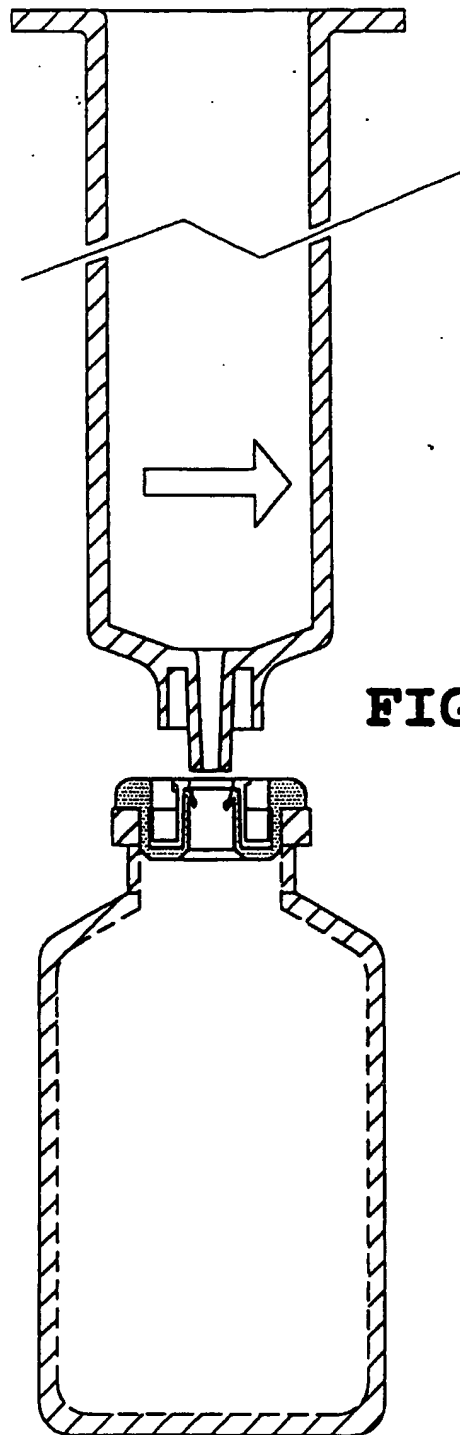
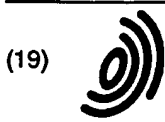


FIG. 13



(19)

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(11)

EP 0 956 849 A3

(12)

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(71) Applicant:
Bracco International B.V.
1077 ZX Amsterdam (NL)

(72) Inventors:
• **Niedospial, John J. Jr.**
Burlington, NJ 08016 (US)
• **Gabbard, Mark E.**
Delmar, DE 19940 (US)
• **Gabbard, Timothy J.**
Salisbury, MD 21804 (US)

(74) Representative:
Gervasi, Gemma, Dr.
NOTARBARTOLO & GERVASI Srl,
Corso di Porta Vittoria, 9
20122 Milano (IT)

(54) Universal stopper

(57) A universal closure assembly designed for use in various containers having a fluid port for access to the contents of a container (10). The universal closure assembly comprising an elastomeric membrane (60) capable of being ruptured by an access means such as a female luer connector (140) or a syringe having a sharp or blunt cannula or a sharp or blunt spike for fluid communication between the contents of the container (10) and the access means.

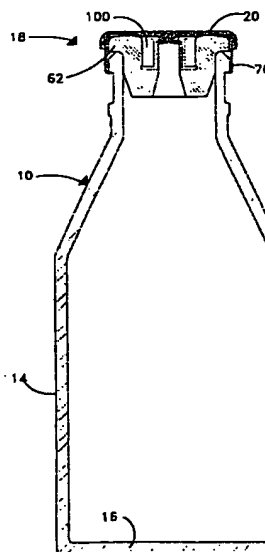


FIG. 4

EP 0 956 849 A3

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EUROPEAN SEARCH REPORT

Application Number
EP 99 10 3307

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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 May 2000	Examiner Baert, F
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EUROPEAN SEARCH REPORT

Application Number
EP 99 10 3307

DOCUMENTS CONSIDERED TO BE RELEVANT			
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A,D	US 5 429 256 A (KESTENBAUM ALAN D) 4 July 1995 (1995-07-04) * abstract; figures *	1	
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 May 2000	Examiner Baert, F
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